Digital Signal Processing(EE323)

Lab 2 Report

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Lab 2.1

Task:

Gram–Schmidt procedure.

Design the function to find the orthonormal vectors from the input vector or matrixes.

Introduction

We can use the steps in PPT to finish this task. Its theoretical formula is

$$e_1 = \frac{v_1}{||v_1||}$$

$$e_j = \frac{t_j}{||t_j||} \ where \ t_j = v_j - \sum_{i=1}^{j-1} (v_j^T e_i) e_j, j = 2, \dots \dots, k$$

In MATLAB, we test two vectors

$$v_1 = [-2 \ 2]^T$$

$$v_2 = [2 \ 1]^T$$

Their position in axis is show in the result as figure.1.

Result

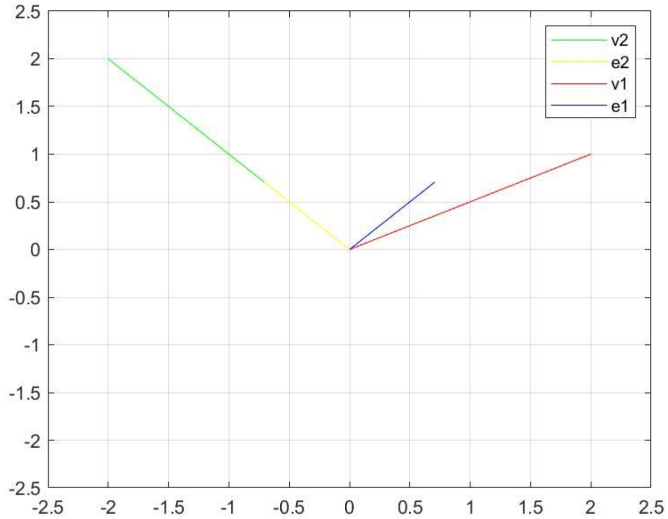


Figure.1 Orthonormal

Lab 2.2

Task:

Tangent Plane

Find paraboloid's tangent plane.

Introduction

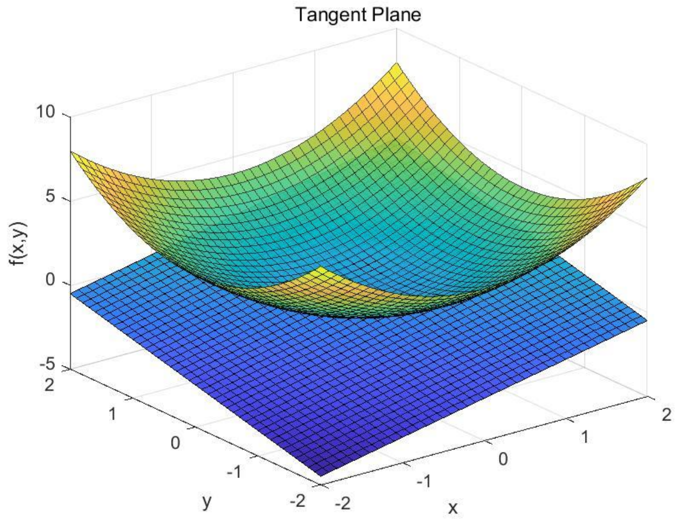
In this part, we use MATLAB's function to find the tangent plane of the input 3–D plane. The input plane is

$$f(x, y) = x^2 + y^2$$

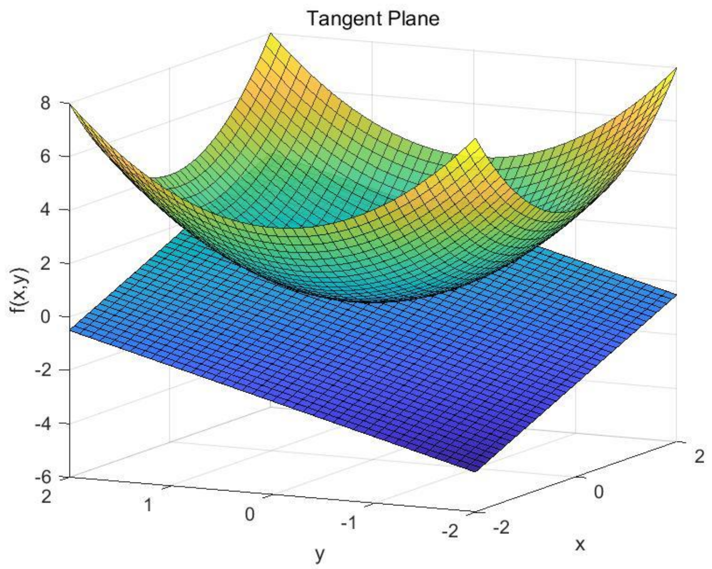
The tangent point is set up as

$$[0.5 - 0.5]^T$$

Result



Firgue.2 Paraboloid and its Tangent plane



Firgue.3 Paraboloid and its Tangent plane

We choose two angles to observe the target.

Lab 2.3

Task:

Polynomial interpolation

Find the local minima, local maximum and function of a polynomial.

Introduction

First, we need to find the coefficient of the polynomial by considering several separating points. We use the *poly* function in MATLAB to do this. Later, we consider the points of 1–st order derivative of polynomial equal to 0. So that, we could find the local minimum and maximum points.

Result

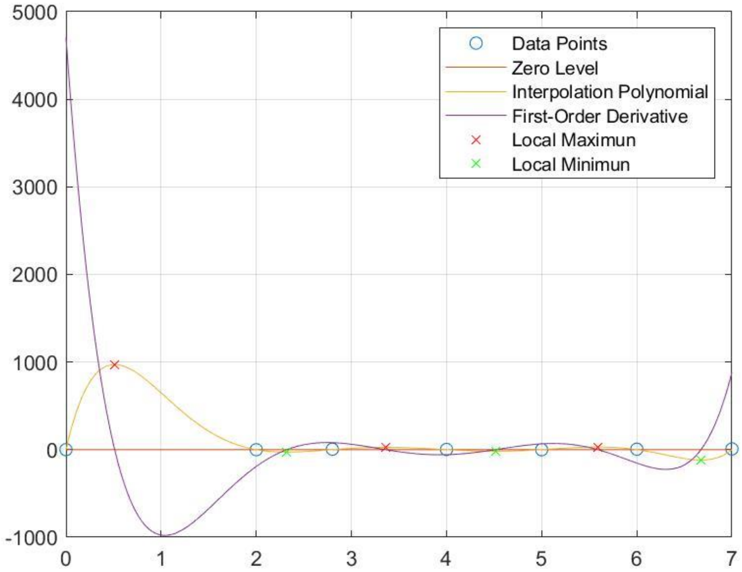


Figure.4 Polynomial Interpolation

All target value and lines are shown in figure.4.

Lab 2.4

Task:

Use numerical methods to solve ODEs.

Introduction

This task we need to design function which could solve ODEs.

We also choose different length of step to solve it. And we have two different ODEs to test. The first one is

$$y' = -y + 3\cos(3\mathrm{t}) * \exp(-\mathrm{t})$$

Its initial point is $y(0) = 0$.We also compare it with the exact solution

$$y(t) = \sin(3t) * \exp(-t)$$

The second equation is

$$y'(t) = t$$

Exact solution is

$$y(t) = \exp(t)$$

Its initial point is $y(0) = 1$.

Result

1) First equation

   The figures are range as the h increasing.

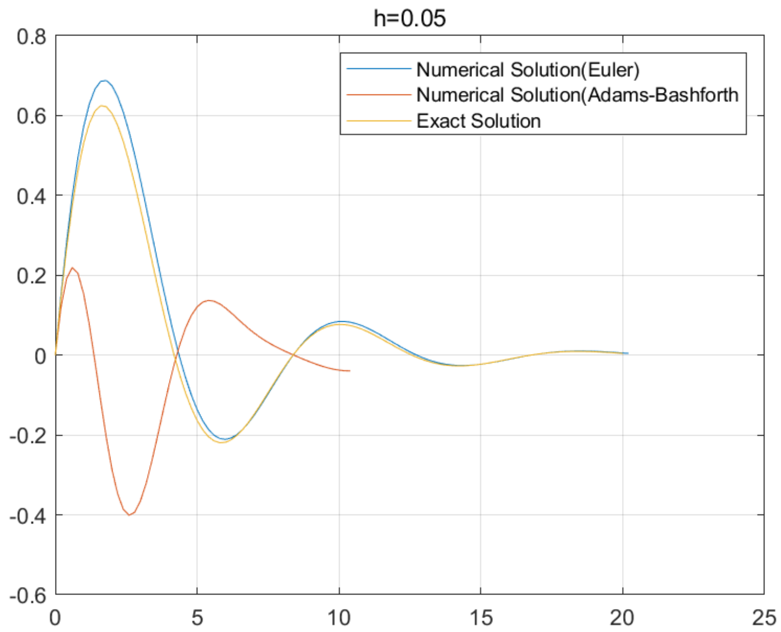


Figure.1 h=0.05

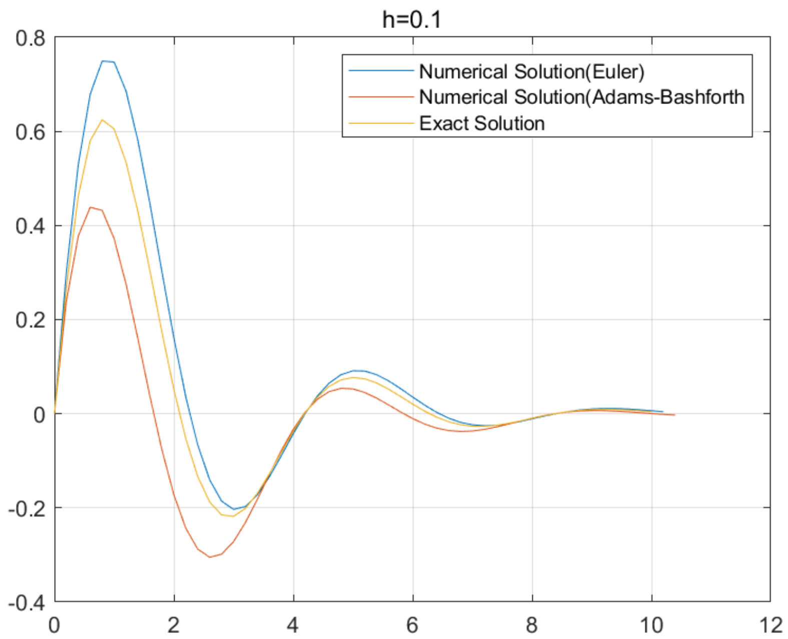


Figure.2 h=0.1

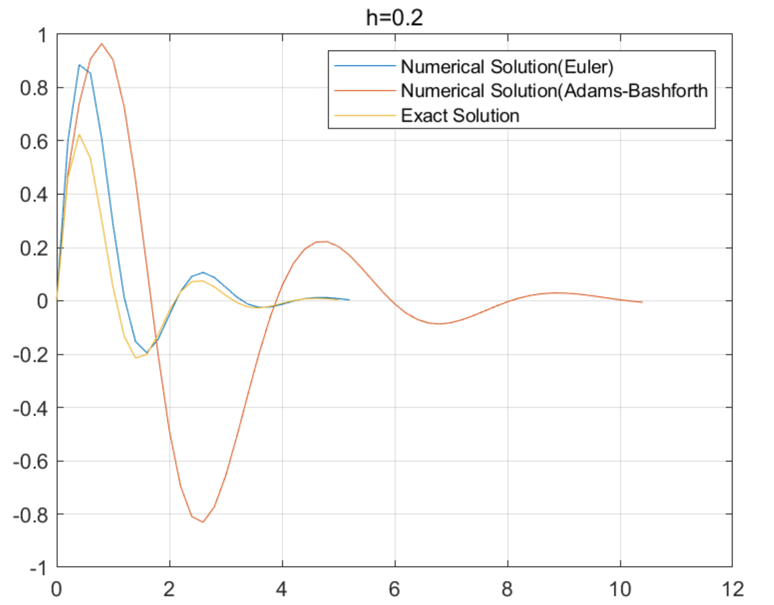


Figure.3 h=0.2

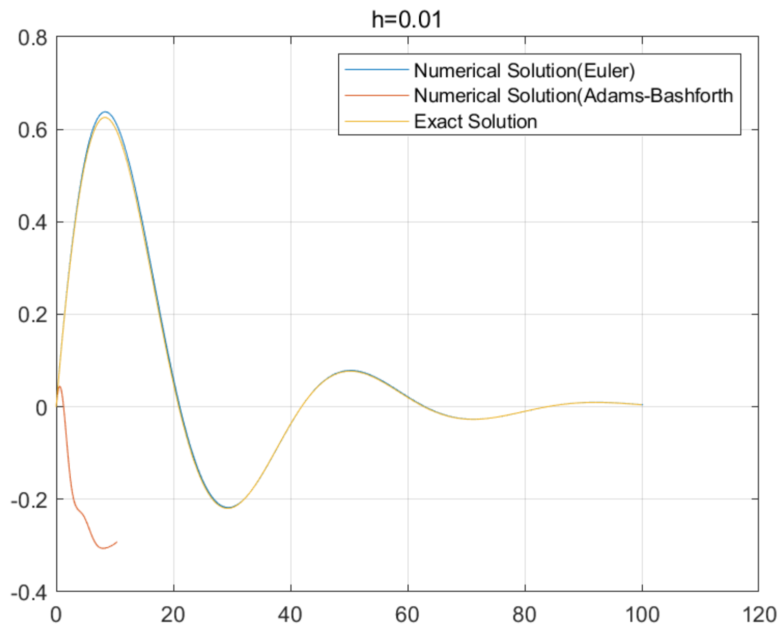


Figure.4 h=0.01

2) Second equation

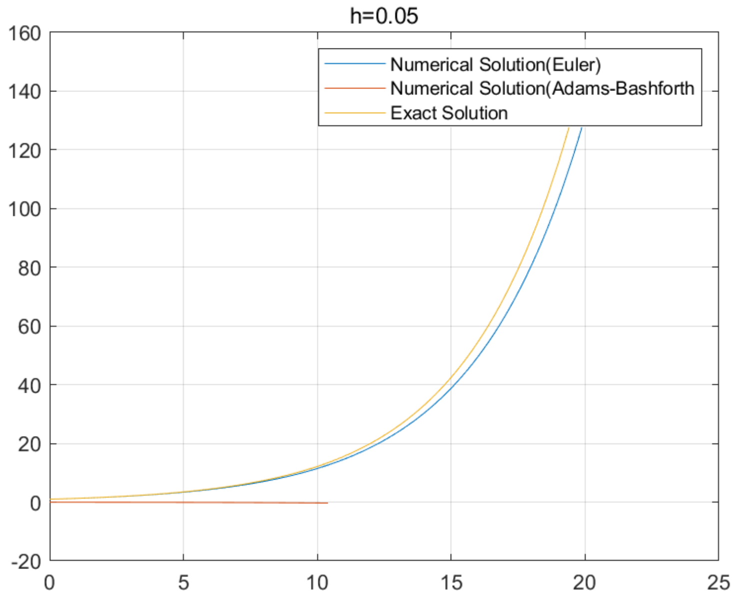


Figure.5 h=0.05

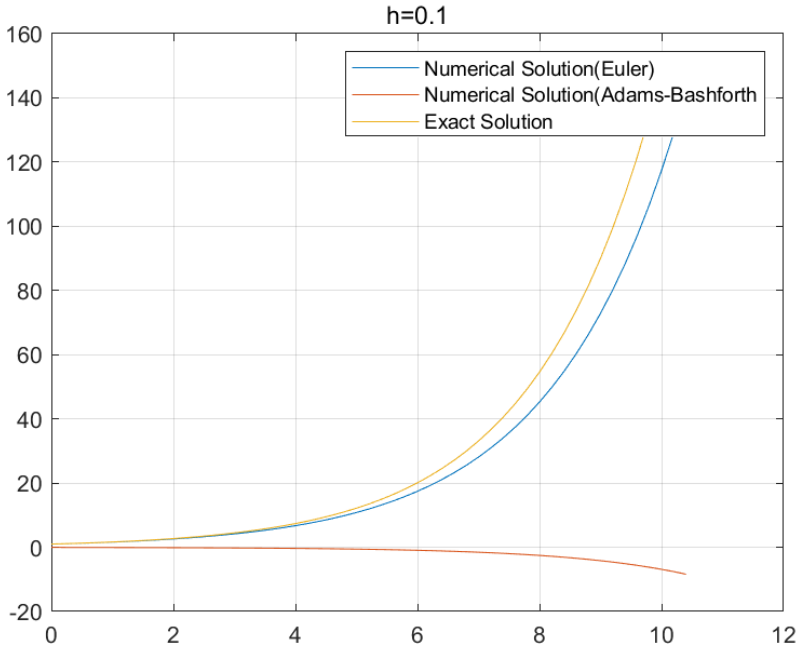


Figure.6 h=0.1

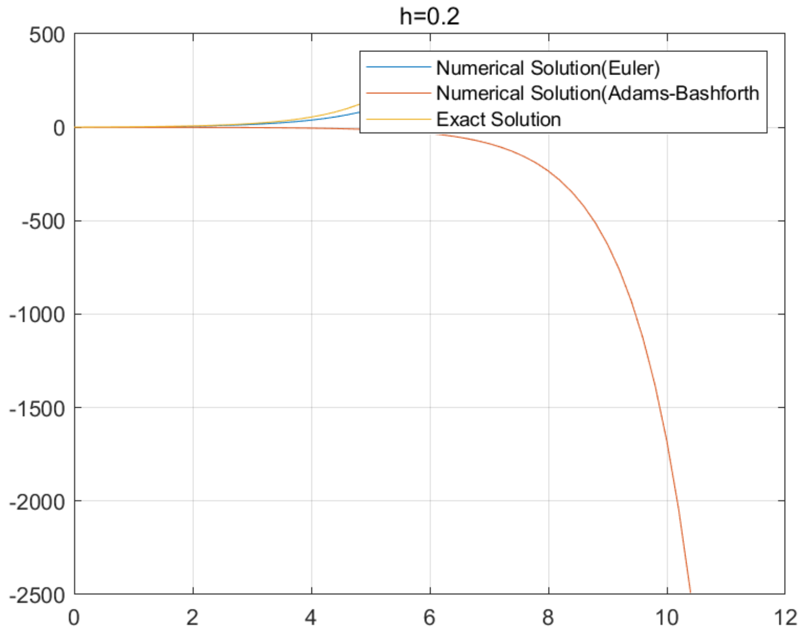


Figure.7 h=0.2

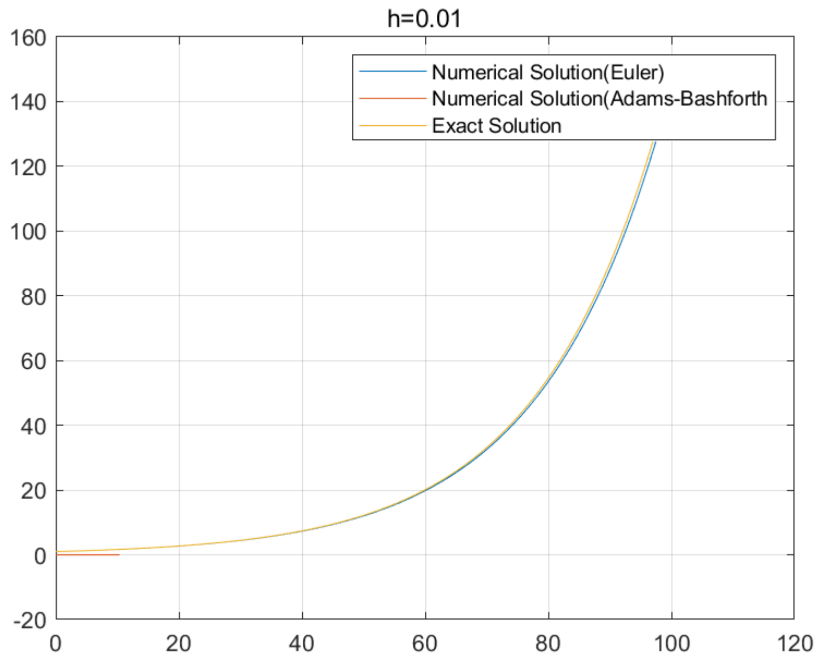


Figure.8 h=0.01

By considering these 8 figures, we can easily find out that the accuracy increase as the step goes smaller which means it is more exactly.